The Determinants of Defense Spending in the Gulf Region: Evidence from Seemingly Unrelated Regressions

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July 8-10, 2020
ERF 26th Annual Conference

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Motivation (1)

- The eight countries in the Gulf Region – Saudi Arabia, Iran, Iraq, Kuwait, Bahrain, Qatar, UAE, Oman – account for 8 per cent of global military expenditures (milex) (SIPRI, 2019).
- The milex in this region has been regularly increasing since the mid 1980s.
- The region hosts three of the ten countries with the world's highest military burden:

  Saudi Arabia (8.8 per cent of GDP),
  Oman (8.2 per cent of GDP),
  Kuwait (5.1 per cent of GDP).

Motivation (2)

For the Gulf Region countries, milex represents an important burden due to the following reasons:

- It is financed out of budget surpluses, which could be used for other purposes such as education, health, or infrastructure.
- It can cause growth rates to decline by diverting government resources away from investments (Dunne and Tian, 2013).
- These countries face important challenges in terms of education, health, employment, poverty and income inequality indicating that the abundant resources are not used sufficiently well.

Motivation (3)

- Why the governments in the Gulf Region keep increasing their milex despite its negative effects on growth and development is a crucial question to answer.
- Analyzing the determinants of milex in the region helps us resolve this dilemma and enable policy makers to reallocate resources toward development related goals rather than to defense.

Motivation (4)

- There are only a few papers on the determinants of defense spending in the Gulf Region countries.
- Most of the existing papers focus on the role of economic or sociopolitical factors such as GDP, oil price, population and institutions.
- The role of strategic factors on milex is generally ignored.

Motivation (5)

Analyzing the strategic dimension is especially crucial in the Gulf Region due to a number of reasons:

- Strong hostilities as well as alliances are commonplace in the neighborhood.
- These countries adjust their milex simultaneously due to facing similar threats such as instability and terrorism.
- Six of the countries are members of the GCC. The GCC states have commitments not only in the economic and social spheres, but also as a defensive alliance (Martini et al., 2016).
- Because of this military alliance, the existence of spill in and free rider effects should be analyzed.
- The role of the US military presence can also affect milex. Hence, whether the US military involvement represents a complement or a substitute should also be explored.

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Contribution

We aim to contribute to the literature in the following ways:

- We use a partial adjustment model in a security web framework for the analysis of military expenditures in the Gulf Region.
- Our model provides a practical approach which takes into account real world technical and institutional rigidities, thereby allowing to estimate both short run and long run elasticities.
- To the best of our knowledge, this is the first study calculating long run elasticities for this country group.
- Our security web concept is comprised of multiple layers which consider the behavior of the rivals, the allies as well as the US.
- We perform a seemingly unrelated regressions (SUR), which allows simultaneous analysis of multiple countries and takes into account complex intercountry correlations.
- We use annual data between 1980 and 2016 in order to provide an up to date analysis in a world of rapidly changing economic, political, and military conditions.

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Literature review

- Asseery (2000) examines the relation between the Iranian and the GCC countries' milex by employing a Granger causality analysis and finds evidence for an arms race model.
- Al-Hamdi (2012) investigates the determinants of milex by using panel corrected standard error estimations (PCSE) and finds that the past milex, conflicts, and oil price affect milex in this region.
- Al-Mawali (2015) explores the effects of different types of natural resources on the milex of the GCC countries and shows that only oil has a significant effect.
- Farzanegan (2018) evaluates the relation between oil rents and the milex of the GCC countries and presents evidence that the effect of oil rents depends on the level of corruption.
- Dizaji and Farzanegan (2019) focus on Iran and find that population, trade and the average milex in the Middle East have a positive effect; while sanctions have a negative effect.

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Methodology (1)

- In this study we adopt a partial adjustment process where, at a given time, a country has a desired level of milex and the adjustment to this optimal level occurs only gradually.
- This can be due to a number of factors such as the lobbying power of interest groups, contractual obligations, overhead costs of dismantling an existing system as well as ambiguities regarding the permanency of a change (Nordhaus et al.,2012).
- Such effects can be examined through a series of adjustments in the milex between subsequent years where the country tries to reach the desired long run equilibrium level.

Methodology (2)

- We adopt a partial adjustment process (Nerlove, 1958) of the form:

$$MX_t - MX_{t-1} = \delta(MX_t^* - MX_{t-1}) \tag{1}$$

- Here

MX_t	observed level of milex at time t,
MX_t^*	desired and unobserved long run level,
$0 < \delta < 1$	coefficient of adjustment.

- $MX_t - MX_{t-1}$ shows the actual change in milex such that $MX_t^* - MX_{t-1}$ represents the desired change.

$\delta = 1$ means that the actual milex is equal to the desired level.

$\delta = 0$ means that milex can never reach its long run equilibrium.

Methodology (3)

- Equation (1) can be rearranged as follows:

$$MX_t = \delta MX_t^* + (1 - \delta) MX_{t-1} \tag{2}$$

- This can be used with a general demand model:

$$MX_t^* = \alpha_0 + \alpha_m \sum_m X_{m,t} + u_t, \tag{3}$$

- where

X_m	$m \times 1$ vector of variables explaning milex,
α	parameters to be estimated,
u_t	error term satisfying the usual conditions.

- Combining (3) and (2) gives the econometric model in log form:

$$\ln MX_t = \delta \ln \alpha_0 + \delta \alpha_m \sum_m X_{m,t} + (1 - \delta) \ln MX_{t-1} + \delta u_t \tag{4}$$

Methodology (4)

- For the estimation of our model, we employ the SUR technique developed by Zellner (1962).
- SUR is a panel method comprised of a system of equations that exhibit contemporaneous cross-equation error correlation.
- Here, even though the equations are separate and seemingly independent, they are actually related through the correlations in the respective error terms.
- This approach is especially useful for the analysis of milex in the Gulf Region because the countries involved tend to determine their level of milex by taking into account many interrelated factors and threats common to the region.
- Such complex relations cannot be fully specified in a regression model and therefore manifest themselves in the error term.
- The SUR method considers such unobserved relationships in order to obtain coefficient estimates which are not only less biased, but also substantially more efficient.

Methodology (5)

- Our final specification for panel estimation is given below:

$$\ln MX_{i,t} = \beta_{i,0} + \beta_{i,m} \sum_{m} X_{i,m,t} + \theta_i \ln MX_{i,t-1} + v_{i,t} \qquad (5)$$

- Here

i	represents the eight Gulf Region countries namely Saudi Arabia, Iran, Iraq, Kuwait, Bahrain, Qatar, UAE, and Oman in that order.
β_m	provide the short run elasticities with respect to X_m.
θ_i	are such that $1-\theta_i$ gives the adjustment parameter δ_i for each country.

The long run elasticities are obtained by dividing β_i,m by $1-\theta_i$.

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Data (1)

We categorize explanatory variables into two groups namely (1) economic variables and (2) strategic variables.

Our economic variables are as follows:

- Real GDP: The use of this variable provides the income elasticity of milex. Because milex is considered to be a normal good, we expect a positive sign.
- Population: Population can have either a positive or negative effect on milex.
- Real oil price: An increase in oil price may provide the governments with additional financial means to be used for military purposes. Hence, a positive relation between oil price and milex is expected.

Data (2)

- Our strategic variables include (1) milex of the allies, (2) milex of the rival countries, (3) milex of the US in the region.
- The rival country is Saudi Arabia for Iran, and Iran for the rest of the countries.
- For all countries except Iran, the ally is the other GCC countries.
- Iran does not have an ally in the region so its ally variable shows the rest of the GCC in order to determine the degree to which GCC countries diverge from Saudi Arabia, the leading power.
- The US is an ally for GCC countries, but it is also a threat for Iran. Therefore, the elasticities with respect to US military presence are also estimated as a third strategic variable.

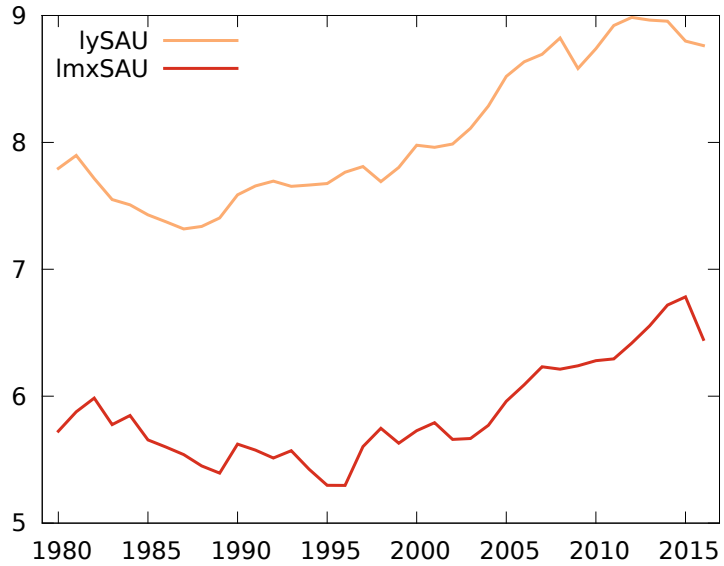
Data (3)

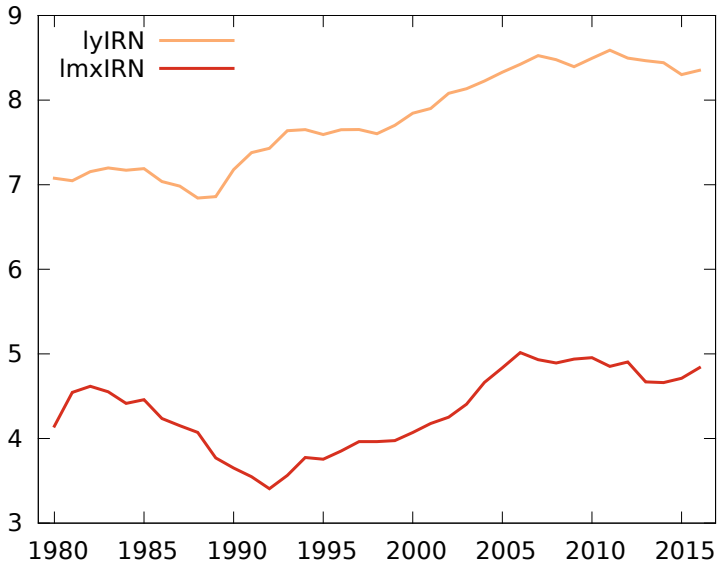
- Our final dataset is annual and covers the period between 1980 and 2016.
- The data sources are as follows:

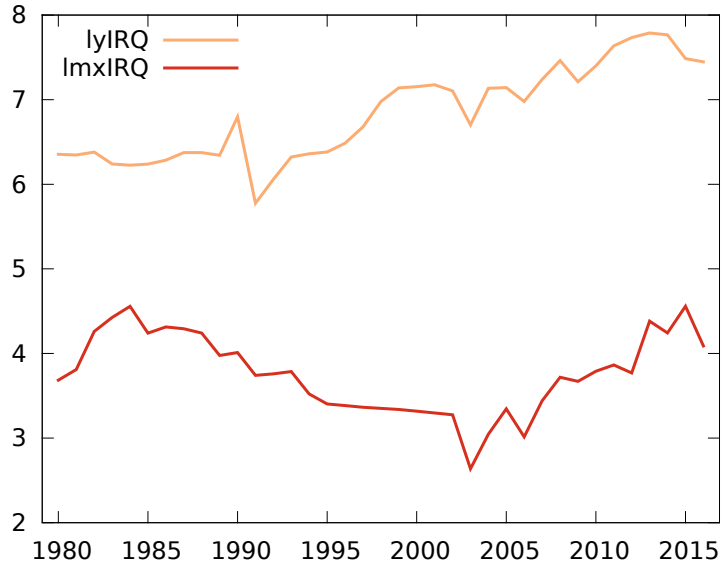
Real milex	SIPRI (2019)
Real income	SIPRI (2019)
Population	World Bank (2019)
Real oil prices	Energy Information Administration (2019)
US mil personnel	Defense Manpower Data Center (2019)

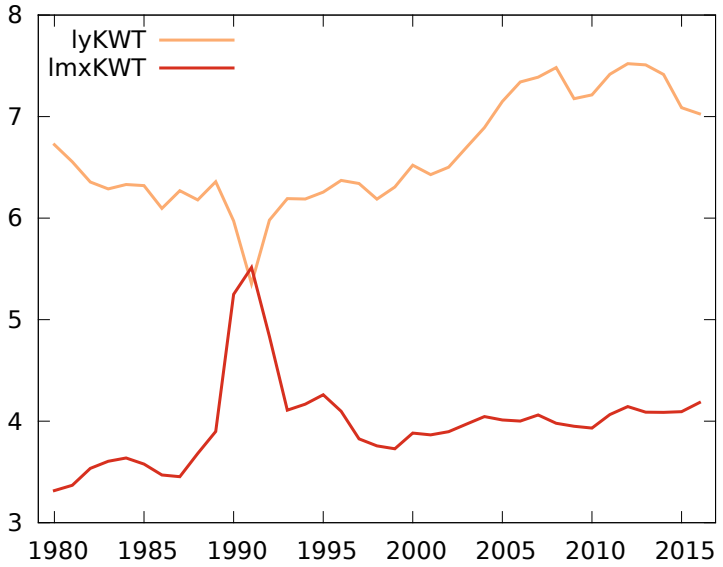
- We calculate the missing values for milex for some countries using the growth rates of the corresponding data provided by Bureau of Arms Control (2019).
- We use active duty US military personnel for the US military presence in the region as suggested by Spangler (2018).

Real Milex and Real GDP (Sau, Irn, Irq, Kwt)

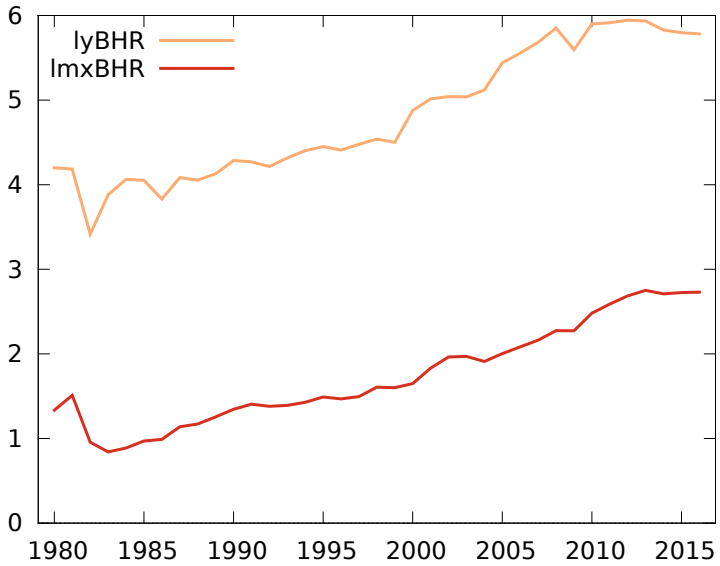


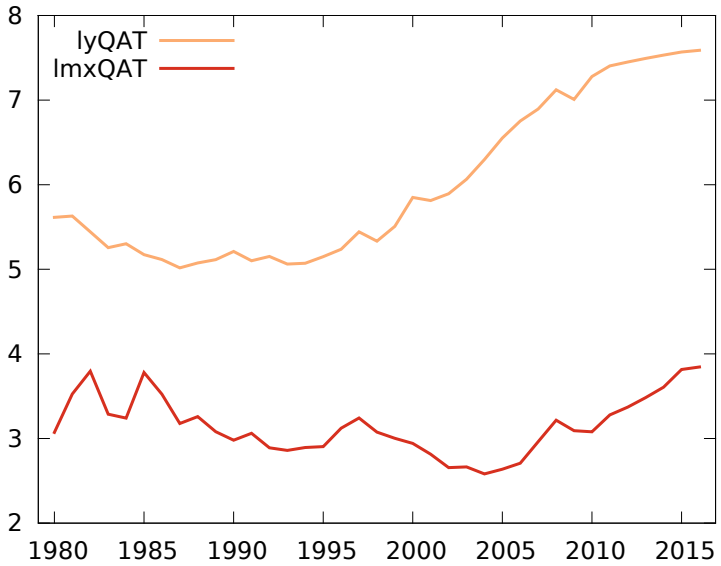


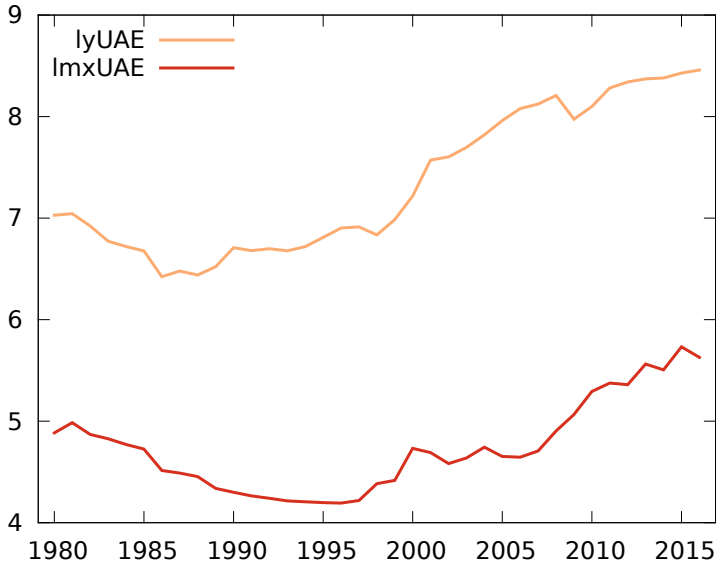


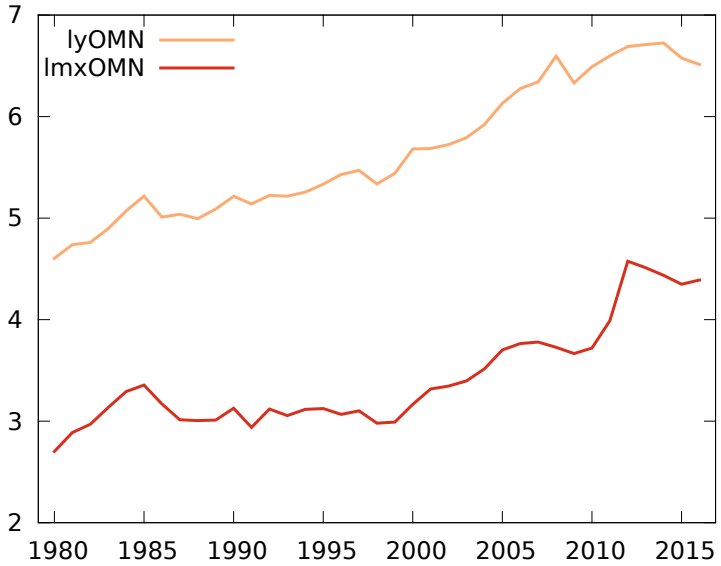


Real Milex and Real GDP (Bhr, Qat, UAE, Omn)









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Empirical results (1)

- The SUR model estimates are presented in Table 1. Each column gives individual regressions for the eight Gulf Region countries.
- Since the partial adjustment model is known to be susceptible to autocorrelation, the Ljung-Box Q test (Ljung and Box, 1978) is performed. The results show that the null of independence is not rejected at the 5 per cent level for all countries.
- Also, the Doornik and Hansen (2008) test for normality of the error term is not rejected with a p-value of 0.385.

Empirical results (2)

Table 1: Regression Estimates for the SUR Model

Dependent variable: *Log of real milex*

	Saudi Arabia	**Iran**	**Iraq**	**Kuwait**	**Bahrain**	**Qatar**	**UAE**	**Oman**
Constant	1.0012*	3.8218**	2.4944**	2.9365***	−0.8883***	−0.2097	−0.2012	−1.5076***
	(0.5551)	(1.5508)	(1.2121)	(0.5505)	(0.1515)	(0.5521)	(0.2847)	(0.4058)
Log of real milex (−1)	0.3539**	0.7267***	0.5329***	0.3413***	0.6825***	0.5121***	0.7601***	0.5090***
	(0.1424)	(0.0764)	(0.1042)	(0.0758)	(0.0579)	(0.1462)	(0.1152)	(0.0997)
Log of real GDP	0.4606***	0.3851***	0.2282*	−0.6154***	0.6549***	−0.0371	0.0233	0.1571
	(0.1632)	(0.1079)	(0.1323)	(0.1091)	(0.0606)	(0.2283)	(0.1058)	(0.1884)
Log of population size	−0.3261	−1.0272***	−0.8597**	0.6712***	−0.5515***	−0.0045	0.0825	0.3595
	(0.2181)	(0.3126)	(0.3491)	(0.1590)	(0.1450)	(0.1903)	(0.0744)	(0.3054)
Log of real price of oil	−0.1211	−0.0604	−0.0125	0.5245***	−0.0932***	0.0817	0.0491	0.1788*
	(0.0930)	(0.0811)	(0.1258)	(0.0875)	(0.0330)	(0.1073)	(0.0598)	(0.0964)
Log of real milex of rival[1]	0.1758*	0.3596***	0.0586	−0.7206***	−0.0832**	0.0130	0.0322	0.0215
	(0.0969)	(0.1196)	(0.1198)	(0.1408)	(0.0322)	(0.1685)	(0.0822)	(0.0753)
Log of real milex of ally	0.3028**	−0.2818***	0.6784***	0.0795	0.1308**	0.5023*	0.1428	0.0709
	(0.1194)	(0.1008)	(0.2231)	(0.1643)	(0.0532)	(0.2604)	(0.1252)	(0.1348)
Log of total US military personnel in the region	−0.0179	0.0156	−0.0654**	0.1398***	−0.0234***	−0.0666**	−0.0114	−0.0313*
	(0.0182)	(0.0170)	(0.0318)	(0.0217)	(0.0069)	(0.0290)	(0.0200)	(0.0171)
t	36	36	36	36	36	36	36	36
$\bar{R}^2$	0.937	0.951	0.859	0.878	0.993	0.779	0.956	0.956
Regression std. error	0.099	0.105	0.177	0.151	0.047	0.162	0.093	0.103
Ljung Box Q (p-value)	0.779	0.854	0.137	0.653	0.051	0.534	0.630	0.402

Note: Standard errors in parentheses. *** indicates significance at the 1% level. ** and * idem, 5% and 10%.

Empirical results (3)

- In the table, it is seen that the parameter estimates have the expected signs in general.
- A large proportion of the coefficients are statistically significant thanks to the improved efficiency provided by the SUR method.
- The lagged military expenditures have a positive and significant effect on milex in all specifications, confirming the existence of inertia. This finding is line with that of Al-Hamdi (2012).
- The coefficients of lagged milex are smaller than one, indicating that our model is dynamically stable in all of the eight cases.
- It is seen that the coefficient of adjustment (calculated as 1 minus the estimated coefficient) is generally high across the region.
- This is not surprising because these countries are some of the largest military spenders in the world.

Empirical results (adjustment variable)

- In Saudi Arabia, 65 per cent of the discrepancy ($1 - 0.3539 = 0.6461$) between the desired and actual milex is eliminated on average each year.
- Other countries have relatively high or low adjustment rates which can be explained with different levels of threat, economic problems as well as free riding behavior on other, bigger countries.
- Also noteworthy is the rather low adjustment rate for Iran ($1 - 0.7267 = 0.2733$). This can be due to the international sanctions constraining its ability to adjust milex towards the optimal level.

Empirical results (economic variables)

- The results reveal that the determinants of milex show variations across different countries.
- Real GDP has a positive effect on milex in Saudi Arabia, Iran, Iraq, and Bahrain. However, in smaller countries (such as Qatar, UAE, and Oman) this coefficient is not statistically significant.
- In Kuwait, the demand for milex decreases as income increases, which indicates that security is perceived as an inferior good.
- As for the effects of population, the results show that a positive effect is more prevalent in Kuwait, while civilian needs seem to dominate in Iran, Iraq, and Bahrain.
- We see that the price of oil has a significant effect only in Kuwait, Bahrain and Oman.
- For other countries such as UAE and Qatar an insignificant effect may be explained with the efforts toward economic diversification in order to reduce oil dependency (Al-Hamdi, 2012).

Empirical results (strategic variables)

- The results point to some interesting findings regarding the strategic variables as well.
- Both Saudi Arabia and Iran react positively to the milex of each other. This confirms that the two countries see the opposite side as a threat.
- Saudi Arabia, Iraq, Bahrain and Qatar increase their milex to keep up with the other countries in the region. This indicates that there is perhaps no free riding among the GCC countries.
- Iraq, Bahrain, Qatar and Oman decrease their milex in response to an increase in the US spending. This shows that these countries rely on the US for their external security (Vittori, 2019).
- The results show that Kuwait is the only country viewing the US milex as complimentary even though it relies on the US for protection as well.

Empirical results (parameter constancy)

- One important result is that the determinants of milex do not only differ but also exhibit large variations in different countries.
- We test this hypothesis by running a series of Wald tests with the null hypothesis of coefficient constancy for different parameters.
- For the case of the adjustment parameter, the proposition that $(1-\theta)$ is equal across the eight countries is rejected with a p-value of 0.0015.
- Similar tests on other parameters give similar results in all cases.
- We encounter only one exception, which is the parameter for the military expenditure of allies. Here, the statistical test provides a p-value of 0.5389 for the six GCC countries only.
- In other words, the hypothesis that the GCC countries do not free ride on each others' milex is not rejected.
- Our tests confirm that, milex is influenced by different factors and with a high degree of heterogeneity in this region.

Empirical results (elasticities)

Table 2: Point estimates of long run and short run elasticities of the model variables

Long Run Elasticities								
Variable	**SAU**	**IRN**	**IRQ**	**KWT**	**BHR**	**QAT**	**UAE**	**OMN**
Real GDP	0.713	1.409	0.489	−0.934	2.063	−0.076	0.097	0.320
Population	−0.505	−3.759	−1.841	1.019	−1.737	−0.009	0.344	0.732
Price of oil	−0.187	−0.221	−0.027	0.796	−0.294	0.167	0.205	0.364
Milex rival	0.272	1.316	0.125	−1.094	−0.262	0.027	0.134	0.044
Milex ally	0.469	−1.031	1.452	0.121	0.412	0.030	0.595	0.144
US presence	−0.028	0.057	−0.140	0.212	−0.074	−0.137	−0.048	−0.064
Short Run Elasticities								
Variable	**SAU**	**IRN**	**IRQ**	**KWT**	**BHR**	**QAT**	**UAE**	**OMN**
Real GDP	0.461	0.385	0.228	−0.615	0.655	−0.037	0.023	0.157
Population	−0.326	−1.027	−0.860	0.671	−0.552	−0.005	0.083	0.360
Price of oil	−0.121	−0.060	−0.013	0.525	−0.093	0.082	0.049	0.179
Milex rival	0.176	0.360	0.059	−0.721	−0.083	0.013	0.032	0.022
Milex ally	0.303	−0.282	0.678	0.080	0.131	0.502	0.143	0.071
US presence	−0.018	0.016	−0.065	0.140	−0.023	−0.067	−0.011	−0.031
Rate of adj.	0.646	0.273	0.467	0.659	0.318	0.488	0.240	0.491

Empirical results (elasticities)

- In line with the theory, the long run elasticities are larger than short run elasticities in all countries.
- Especially the income elasticity is substantially higher in Iran and Bahrain, exceeding 1.
- The sensitivity of milex to the changes in population increases over time. In Iran, Iraq, Bahrain, and Kuwait this elasticity becomes greater than unity in the long run.
- The short run elasticity with respect to oil price is 0.53 in Kuwait, while it is 0.09 and 0.18 for Bahrain and Oman respectively.
- As for the effect of rival country's milex, it is seen that Iran is more responsive to Saudi Arabia than vice versa.
- All GCC countries except Kuwait respond positively to Iran's milex.
- The elasticity with respect to the US presence is negative in Iraq, Bahrain, Qatar and Oman; although it is low in general.

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Policy implications

- Better coordination among the GCC countries is necessary to reduce milex in favor of development programs.
- Such planning can also bring more flexible policies to avoid long-term defense contracts, an important obstacle for reducing milex in the region (Jarzabek, 2016).
- We see that while Kuwait views the US presence as a complement; Iraq, Bahrain and Qatar regard it as a substitute, resulting in free riding behavior. If the US decides to reduce its milex, these countries may in turn need to increase theirs.
- Oil prices have been influential in the milex of some countries namely Kuwait, Bahrain, and Oman. Therefore, these countries have more to gain by diversifying their economies to decrease dependence on oil revenues.
- In conclusion, the eight countries as well as the US may benefit from reevaluating their security policies in the Gulf Region.

Discussion

Questions?

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